

unpatentable over Ho in view of Vacanti et al. (U.S. Patent 4,559,489, hereinafter "Vacanti"). Claims 1, 4, 8-11 have been amended. Claims 16-34 have been added. No new matter has been added to the application. Acceptance is respectfully requested.

The present invention relates to a varactor based phase shifter that increases phase shift range using a lower characteristic impedance between quadrature ports than is used at its input/output ports. The circuit uses a four port coupler arrangement that imbeds a quarter-wave impedance transformation between the input port and the quadrature ports as well as between the quadrature ports and the output port.

The Ho patent provides for an impedance coupler which may be used as a power divider or power combiner at microwave frequencies. As shown in Fig. 3, the coupler comprises four ports, designated as ports 1, 2, 3, and 4 respectively. Ports 1 and 4 are input ports and ports 2 and 3 are output ports. The signals applied at port 1 can be reversed with the signals applied at port 4, and the signals applied at port 2 can be reversed with the signals applied at port 3 because the coupler is symmetric about a horizontal line bifurcating the a and c normalized admittances. (See Ho, Column 4, lines 6-18). Therefore, input port 4 cannot be an output port as claimed in the present invention. Further, with reference to Fig. 2, the input port (port 1) is not coupled to output port (port 3) as claimed in the present invention. Furthermore, ports 2 and 3 are output ports and therefore cannot be a first and second quadrature ports as claimed in the present invention.

Ho does not anticipate or otherwise make obvious "the output port coupled to the input port, such coupling between the input port and output port having a characteristic input/output impedance; a first quadrature port and a second quadrature port, the first and second quadrature ports coupled to one another, such coupling between quadrature ports having a characteristic quadrature port impedance, being different from the input/output port impedance; a first impedance transformer coupled between the input port and a first one of the quadrature ports, the first impedance transformer transforming the characteristic input/output impedance across the input/output ports to the characteristic quadrature port impedance across the quadrature ports; and a second impedance transformer coupled between a second one of the quadrature ports and the output port, the second impedance transformer transforming the characteristic quadrature port impedance across the quadrature ports to the characteristic input/output impedance," as claimed

in the present invention. Applicants respectfully request withdrawal of the rejection of amended base claim 1.

Claims 2-15, 33, and 34 are dependent on amended base claim 1 and therefore contain all the elements of amended base claim 1. Since the elements of amended base claim 1 have been argued above to be unanticipated and non-obvious then each of the claims 2-15, 33 and 34 are unanticipated and non-obvious by the cited references. Additional limitations recited by claims 2-15, 33 and 34 further distinguish claims 2-15, 33 and 34 from the cited references. Therefore, Applicants respectfully request withdrawal of the rejection of claims 2-15, 33 and 34.

Claims 16-33 are method claims of claims 1-15, 33 and 34 and are believed to be in condition for allowance for the same reasons as claims 1-15, 33 and 34. Acceptance of claims 16-33 is respectfully requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims (1-34) are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned at (978) 341-0036.

Respectfully submitted,

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MARKED UP VERSION OF AMENDMENTS

Claim Amendments Under 37 C.F.R. § 1.121(c)(1)(ii)

1. (Amended) A phase shifter circuit for imparting a phase shift to an input signal applied at an input port such that [the] a phase shifted signal appears at an output port, the circuit comprising:
- an input port coupled to receive the input signal;
 - an output port coupled to provide the phase shifted output signal, the output port coupled to the input port, such coupling between the input port and output port having a characteristic input/output impedance;
 - a first quadrature port and a second quadrature port, the first and second quadrature ports coupled to one another, such coupling between quadrature ports having a characteristic quadrature port impedance, being different from the input/output port impedance;
 - a first impedance transformer coupled between the input port and a first one of the quadrature ports, the first impedance transformer transforming the characteristic input/output impedance across the input/output ports to the characteristic quadrature port impedance across the quadrature ports; and
 - a second impedance transformer coupled between a second one of the quadrature ports and the output port, the second impedance transformer transforming the characteristic quadrature port impedance across the quadrature ports to the characteristic input/output impedance.
4. (Amended) An apparatus as in Claim 1 wherein the coupling between the input port and the output port is provided by coupled lines.
8. (Amended) An apparatus as in Claim 1 wherein at least one varactor diode is coupled to at least one quadrature port.

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9. (Amended) An apparatus as in Claim 1 wherein at least one varactor diode is coupled to each of the quadrature ports.
10. (Amended) An apparatus as in Claim [8] 9 wherein an input bias voltage is applied to at least one of the varactor diodes.
11. (Amended) An apparatus as in Claim [9] 10 wherein the voltage of the input bias voltage determines an amount of phase shift imparted by the phase shifter.